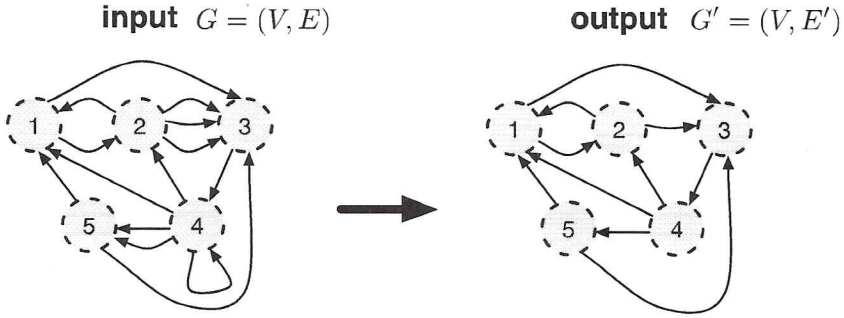
Name: Maura Kieft
ID: 103947905

CSCI 3104 **Profs. Grochow & Layer**
Problem Set 7 **Spring 2019, CU-Boulder**

4. (25 pts) Deep in the heart of the Hogwarts School of Witchcraft and Wizardry, there lies a magical grey parrot that demands that any challenger efficiently convert directed multigraphs into directed *simple* graphs. If the wizard can correctly solve a series of arbitrary instances of this problem, the parrot will unlock a secret passageway.



1	3	2			
2	1	3	3	3	
3	4				
4	4	5	2	5	1
5	3	1			

1	2	3	
2	1	3	
3	4		
4	1	2	5
5	1	3	

An example of transforming $G \to G'$

Let $G = (E, V)$ denote a directed multigraph. A directed simple graph is a $G' = (V, E')$, such that E' is derived from the edges in E so that (i) every directed multi-edge, e.g., $\{(u, v), (u, v)\}$ or even simply $\{(u, v)\}$, has been replaced by a single directed edge $\{(u, v)\}$ and (ii) all self-loops (u, u) have been removed.